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Office of Pesticide and Toxic Substances

EPA

PCB Marking and Disposal Regulations Support Document

PCB MARKING AND
DISPOSAL REGULATIONS -
SUPPORT DOCUMENT

ENVIRONMENTAL PROTECTION AGENCY

(40 CFR Part 761)

(OTS - 068005)

Toxic Substances Control

Polychlorinated Biphenyls (PCBs)

PCB MARKING AND DISPOSAL REGULATIONS - SUPPORT DOCUMENT

INTRODUCTION

This Support Document for PCB Marking and Disposal Regulations provides information and data that expand the basis for this rulemaking contained in the Preamble. This Document provides a history of events leading to EPA's initiation of this rulemaking. This Document also includes a reference to the very detailed discussion of the health and environmental effects of PCBs presented in the preamble to the toxic pollutant effluent standards for PCBs which were promulgated by EPA on February 2, 1977, under the authority of Section 307(a) of the Federal Water Pollution Control Act. Those standards are attached to this Document as an Appendix.

This Document also includes a discussion of the economic consequences of the proposed regulations. The discussion is derived from a report entitled Microeconomic Impacts of the Proposed Marking and Disposal Regulations for PCBs submitted to EPA under contract by Versar, Inc., of Springfield, Virginia (a research and consulting firm) in April 1977.

Finally, this Document includes the Official Record of Rulemaking -- Marking and Disposal Regulations.

I. BACKGROUND

Polychlorinated biphenyls (PCBs) are mixtures of the chemical compounds formed by the chemical bond of two benzene molecules (biphenyl) with varying numbers of chlorine atoms attached to the biphenyl molecule. The biphenyl molecule has ten positions to which chlorine can be attached. There are 209 theoretically possible isomers; that is, there are 209 different ways in which one to ten chlorine atoms may replace hydrogen ions on the biphenyl molecule. About 100 different chlorobiphenyl isomers are found in commercial PCBs. The pure isomers of chlorinated biphenyls are crystalline at normal temperatures.

PCBs are among the most stable organic compounds known and exhibit other properties that render them extremely advantageous for use as dielectric and heat transfer fluids.

The synthesis of PCBs was reported as long ago as 1881. Successful commercial production of PCBs in the United States began in 1929.[1/2/] With minor exceptions, the Monsanto Industrial Chemicals Corporation has been the sole U.S. producer of Aroclors* for several years. Some domestic equipment manufacturers either modify Aroclor themselves or have Monsanto prepare special formulations for them. These have been marketed and used in their products under the vairous trade names listed below:

* Registered Trademark. (This will not be footnoted further in the text, either separately or in conjunction with a specific Aroclor, such as 1016, 1242, 1248, 1254, 1260, or 1262.

Name:	Manufacturer
Aroclor*	Monsanto
Aroclor B*	Mallory
Asbestol*	American
Askarel**	Hevi-Duty
Askarel**	Ferranti-Packard
Askarel**	Universal Mfg.
Chlorextol*	Allis-Chalmers
Chlorinol*	Sprague Electric
Clorphen*	JARD
Diaclor*	Sangamo Electric
Dykanol*	Cornell Dubilier
Elemex*	McGraw Edison
Eucarel*	Electric Utilities
Hyvol*	Aerovox
Inerteen*	Westinghouse Electric
No-Flamol*	Wagner Electric
Pyranol*	General Electric
Saf-T-Kuhl*	Kuhlman Electric
Pydraul*	Hydraulic Fluids
Therminol*	Heat Transfer Fluids

* Registered trademark

** Generic name used for nonflammable insulating liquids in transformers and capacitors.

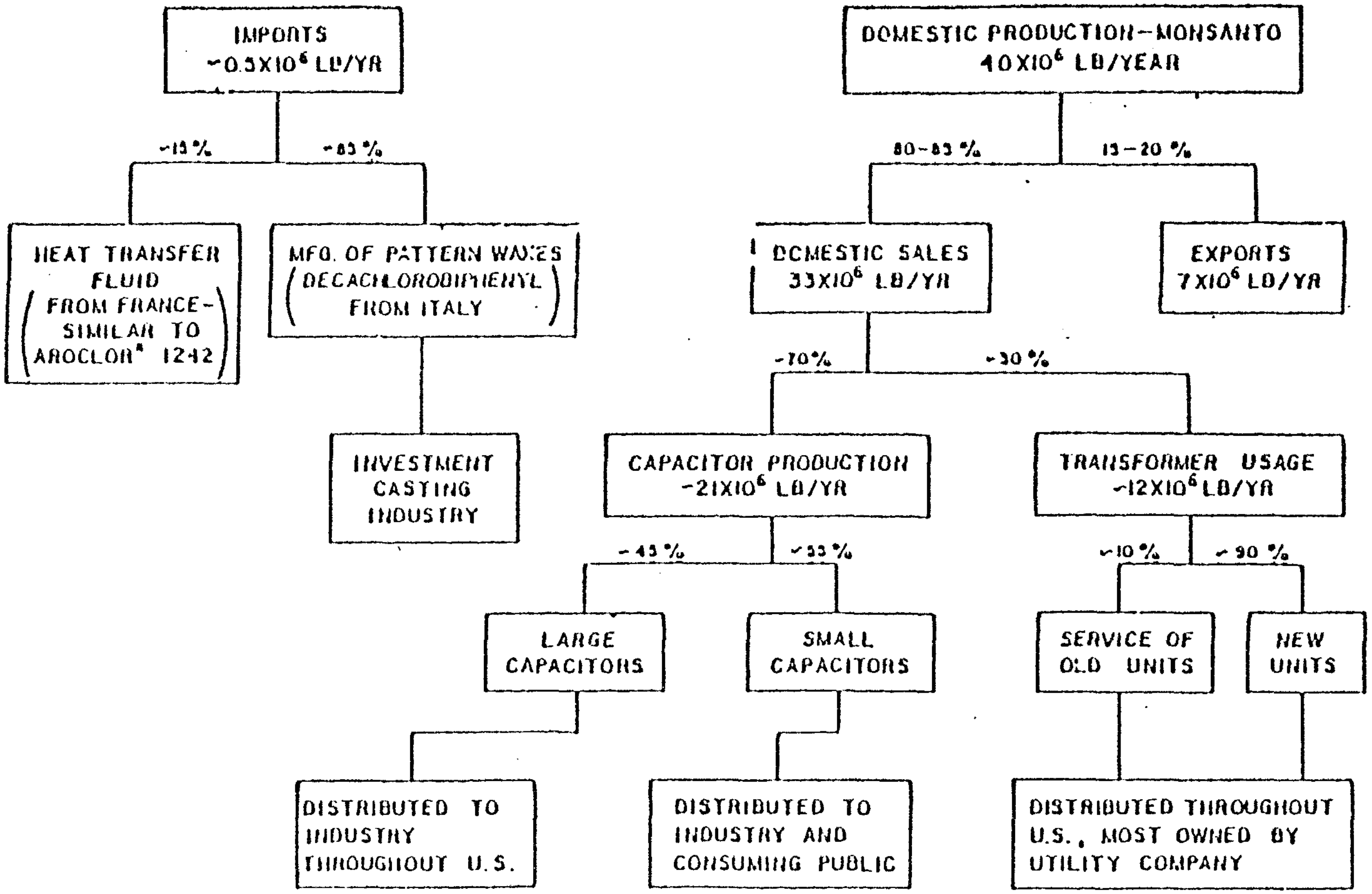
Other domestic usage depends on imported PCBs known to originate in Italy and France. Some PCBs may be imported from other countries, but this has not been definitely ascertained. Decachlorobiphenyl is imported from Italy for use in investment casting wax, and the various PCBs imported from France are used in the cooling systems of mining machinery.1/

An estimated 65 to 70 percent of domestic sales of PCBs is to manufacturers of alternating current liquid impregnated capacitors, and the remainder to manufacturers of transformers.1/ Transformers, which contain 2,000 to 2,500 pounds of PCBs on the average (normally a mixture of 60 to 70 percent PCBs and 30 to 40 percent trichlorobenzene) are primarily used to modify voltages during the distribution of electrical power. Approximately five percent of the transformers in service in this country contain PCBs. Most transformers now contain mineral oil instead of PCBs. Capacitors containing PCBs are of two general types: small capacitors that are built into electrical equipment such as fluorescent lights, TV sets, and small motors; and large capacitors that are used as separate units in electrical power distribution systems and in large industrial equipment, such as electrical motors and welding machines. PCBs are used in about 95 percent of U. S.-produced liquid-impregnated capacitors (most small capacitors in radios and other electronic equipment are non-PCB-containing solid state units). 1/

Over the past four years the domestic production and use of polychlorinated biphenyls (PCBs) has been approximately constant at 40 million lbs/year. 1/ Figure 1 summarizes the distribution of domestic and imported PCBs. 1/

Estimates developed for total PCBs production and use in the U. S. since their introduction to industry in 1929-30 are presented in Table 1. 1/ These data define the estimated proportions of PCBs used in various applications, and an accounting, based on available data plus estimates, of the current distribution of this material. Of the roughly 1.25 billion pounds purchased by U. S. industry, it is estimated that only 55 million pounds, or 4.4 percent, have been destroyed by incineration or by degradation in the environment. About 60 percent of the total domestic sales is still in service -- almost all in capacitors and transformers. The remainder, about 440 million pounds, is in the environment. 1/ It is estimated that 290 million pounds are in landfills or dumps and 150 million pounds are "free" in the general environment (air, water, soil, sediments)

Figure 1



U.S. PRODUCTION AND USAGE OF PCBs
SUMMARY OVER 1972-75

Table 1

Estimates of Cumulative PCBs Production, Usage, and Gross Environmental Distribution in the United States Over the Period 1930-1975 in Millions of Pounds

	Commercial Production	Commercial Sales	Industrial Purchases of PCB	PCBs Currently in Service	PCBs Currently in Environment	PCBs Destroyed	Estimat Reliabili of Value
.S. PCB Production	1,400						+ 5% - 20%
otal U.S. PCB Imports	3						± 30%
.S. PCB Domestic Usage		1,253					+ 5% - 20%
otal U.S. PCB Exports		150					± 20%
CB by Use Category:							
Petroleum Additives			1				± 50%
Heat Transfer			20				± 10%
Misc. Industrial			27				± 15%
Carbonless Copy Paper			45				± 5%
Hydraulics and Lubricants			80				± 10%
Other Plasticizer Uses			115				± 15%
Capacitors			630	450			± 20%
Transformers			335	300			± 20%
Uses Other than Electrical							± 60%
PCB Degraded or Incinerated:							
Environmentally Degraded						30	± 70%
Incinerated						25	± 10%
ls and PCBs in Dumps:							
and Trans. Production Wastes					110		± 20%
Obsolete Ele. Equipment					80		± 40%
Other (paper, plastic, etc.)					100		± 40%
Free PCBs in the Environment (soil, water, air, sediment)					150		± 30%
Total	1,403	1,403	1,253	750	440	55	

Source: Versar Inc.

and presumably available to the biota.

The amount of PCBs in landfills and dumps is about two times the amount of PCBs already free in the environment. The material in land disposal sites may be considered likely to become widely dispersed over a long period of time. The length of time required can only be speculated, but it is probably short in comparison to the time required for degradation of PCBs by natural processes. Thus, release of PCBs from landfills by slow volatilization and leaching could compound an already severe environmental problem. 1/ 3/

A material balance for PCBs production, sales, distribution, and production wastes in 1974 is presented in Table 2. 1/ 4/ The reliability of the values was estimated by the same methods used in Table 1. The amounts listed under "scrap PCBs incinerated" are based on all of the PCBs incinerated (at the recommended temperature-time conditions of 2000 degrees and 2 seconds dwell time) in the U. S. during 1974.

A tabulation of the best available estimates of the amount of PCBs presently in use in electrical equipment is included in Table 3. 5/ These data reflect what is currently estimated to be in service and the normal li expectancy of a new article or equipment.

The failure rate of electrical transformers and capacitors is very low -- less than one percent per year. Further, the likelihood of loss of PCBs as a result of equipment failure is less than one-tenth of the failure rate because transformers and capacitors are constructed using sealed containers of high quality. These containers can be damaged in accidents which result in the loss of PCBs. Transformers and capacitors are usually

Table 2

Estimated Production, Usage, and Losses of PCBs in the United State During 1974 in Millions of Pounds

	Production or Imports	Commercial Sales	Industrial Purchases by Category	Amount Disposed or Lost	Estimated Reliability of Values
Domestic Production	40.466*				± 10%
Total Imports	0.45				± 50%
Monsanto Domestic Sales		34.406*			± 10%
Exports		5.395*			± 10%
Import Sales		0.45			± 50%
From Mfg. Inventory, etc.		0.663*			± 10%
PCBs Usage by Product Category					
Capacitors			22.0		± 20%
Transformers			12.0		± 20%
Investment Casting Wax			0.4		± 20%
Other			0.05		± 70%
PCBs Disposal to Land (assume PCBs to be 30% of total solid wastes)					
From PCBs manufacture				0.03	± 50%
From capacitor industry				0.48	± 50%
From transformer industry				0.27	± 50%
From investment casting				0.4	± 30%
Incineration of Scrap PCBs					
From PCBs manufacture				0.52	± 15%
From capacitor industry				1.45	± 20%
From transformer industry				0.64	± 20%
Industrial Discharges to Water and Sewers (as PCBs)					
From PCBs manufacture				0.0011**	± 40%
From capacitor industry				0.0021**	± 60%
From transformer industry				0.0001**	± 60%
Spills during Transport				0.01	± 50%
Totals	40.316	40.316	35.45	3.40	

* From Monsanto data

** Developed from data supplied by industry. Most analyses for PCBs concentrations in industrial wastewaters are probably not more accurate than ± 50 per cent.

Source: Versar Inc.

Table 3

Estimated Current Uses of Electrical Equipment Containing PCBs

Transformers (5% of all liquid filled transformers) (40 year life)

140,000 @ 2150 lb PCB (3000 lb liquid) = 300,000,000 lb PCBs

60% utility
20% office, apartment, commercial buildings
20% industrial buildings

Large High Voltage (Power Factor) Capacitors (20 year life)

8,000,000 units @ 25 lb PCB = 200,000,000 lb PCBs

95% utility
5% industrial

Fluorescent Light Ballasts (15 year life)

800,000,000 @ .1 lb PCB = 80,000,000 lb PCBs

95% large buildings
5% homes

High Intensity Light Ballasts (20 year life)

25,000,000 @ 2 lb PCB = 50,000,000 lb PCBs

3% utility
77% highway dept.
20% buildings

Small Appliance Capacitors (TV, microwave ovens, room air conditioners) (15 year life)

50,000,000 @ 1 lb PCB = 50,000,000 lb PCBs

90% homes
10% large buildings

Large Low Voltage Capacitors (motors, welding machines, etc.) (15 year life)

20,000,000 @ 3.5 lb PCB = 70,000,000 lb PCBs

5% utility
75% industrial and commercial
20% homes

GRAND TOTAL: 750,000,000 lb PCBs in us

removed from service due to obsolescence rather than because of failure. [1/] [5/]

In 1966, PCBs were found in fish in the Baltic Sea.[6/] These chemicals then were discovered in birds and other animals. PCBs have now been demonstrated to be globally distributed. [7/] In 1969, PCBs were determined to be the causative agent in an outbreak of a disease in Japan now called "Yusho" or "rice-oil" disease, which stemmed from PCB-contaminated cooking oil.[7/]

Thus, in a relatively short period of time, a man made compound which was introduced into commerce for a relatively narrow purpose, a contained use, was broadened through new applications and distributed into the environment, and then discovered to be hazardous to animals, birds, fish, and man.

In 1971, there was concern that PCBs appeared to be an ever-expanding problem whose potential limits were essentially unknown.[7/] By mid-1971, Monsanto had voluntarily terminated sales of Aroclors (PCBs) and polychlorinated terphenyls (PCTs) for all but closed electrical system uses. At the same time, Monsanto offered to incinerate all liquid waste PCBs, and terminated production of the most highly chlorinated Aroclors.[8/]

In December of 1971, the U.S. Department of Health, Education, and Welfare convened a two-day open meeting to discuss the widespread use and dispersion of PCBs. The meeting was broadly attended by scientists and administrators from throughout the world who were concerned with this problem.[9/]

During 1972 and 1973, the Food and Drug Administration established limitations on PCBs concentrations which were designed to eliminate the int. state transportation of a number of PCB-contaminated foodstuffs and the use of PCB-containing food packageing materials.4/ 10/

In November 1975, EPA, in cooperation with other Federal agencies, held a National Conference on Polychlorinated Biphenyls (PCBs) which discussed the latest findings about these chemical substances.4/

Limitations on discharges of toxic pollutants like PCBs from wastewater streams are authorized by Section 307(a) of the Federal Water Pollution Control Act (P.L. 92-500; 33 U.S.C. 1317(a)). Such a limitation, in the form of a standard, has been promulgated for electrical capacitor manufacturers and electrical transformer manufacturers (40 C.F.R. 129, published in the Federal Register on February 2, 1977 (42 FR 6532)).

The discussion of the adverse environmental and health effects of PCBs contained in the preamble to those effluent standards is detailed and inclusive. That discussion is included in the Appendix to this document.

FOOTNOTES

1/ USEPA -OTS. PCBs in the United States: Industrial Use and Environmental Distribution. Feb. 25, 1976. Versar, Inc.

2/ Hutzinger, O., Safe, S., Zitko, V. The Chemistry of PCBs. 1974. CRC Press.

3/ USEPA-OSWMP. Preliminary Assessment of PCB Disposal in Municipal Landfills and Incinerators. Undated.

4/ USEPA -OTS. National Conference on Polychlorinated Biphenyls, Nov. 19-21, 1975. Chicago, Ill. March 1976.

5/ USEPA-OTS. Microeconomic Impacts of the Proposed Marking and Disposal Regulation for PCBs. EPA 560/6-77-013. April 1977. Versar, Inc.

6/ National Swedish Environment Protection Board. PCB Conference Sep. 29, 1970. Stockholm. Dec. 1970.

7/ Interdepartmental Task Force on PCBs. Polychlorinated Biphenyls and the Environment. May 1972. Washington, D.C.

8/ Monsanto Co. Presentation to the Interdepartmental Task Force on PCBs. May 15, 1972. Washington, D.C.

9/ US-DHEW, NIH, National Institute of Health Sciences. Environmental Health Perspectives, Environmental Issue, No. 1, April 1972.

10/ 38 F.R. 18096 (July 6, 1973).

II. ECONOMIC CONSEQUENCES

General

The proposed regulations cover:* the marking of newly manufactured PCBs and PCB-containing equipment; and the marking, storage for disposal, disposal, and recordkeeping requirements for existing PCBs and manufactured items which contain PCBs. The proposed effective date of these regulations is January 1, 1978. The EPA has funded an independent analysis of the economic impacts of these regulations. The results of this study were reported in the Task Report Microeconomic Impacts of the Proposed Marking and Disposal Regulations for PCBs.[1/] Limited numbers of this report are currently available from the Office of Toxic Substances, and the report will shortly be published through the National Technical Information Service (NTIS). The following paragraphs and tables which summarize the estimates of the economic impacts of the proposed regulations are taken from this report.

The Toxic Substances Control Act requires that PCBs not be used after January 1, 1978, except in a totally enclosed manner. Electrical equipment manufacturers have indicated that there will probably be no PCB-containing transformers or large capacitors manufactured after 1977, and only two manufacturers of small capacitors have indicated that they may continue to use PCBs in their products during 1978. Therefore, the proposed rules will have minimal impact on new PCBs.

The major impact of the rules will apply to the owners and users of currently operating PCB capacitors and transformers. These persons will be affected by increased costs due to the special marking, storage, disposal, and recordkeeping that will be required for this equipment.

* See Addendum

For purposes of analysis, existing PCB electrical equipment has been classified in accordance with the following categories:

PCB transformers @:

2150 lb PCBs
3000 lb liquid
6500 lb drained weight
40 year average life

Large High Voltage Capacitors (LHV) @:

25 lb PCBs
120 lb Total
20 year average life

Large Low Voltage Capacitors (LLV) @:

3.5 lb PCBs
20 lb Total
15 year average life

High Intensity Discharge Lighting Capacitors (HID) @:

2 lb PCBs
8 lb Total
20 year average life

Small Appliance Capacitors (SA) @:

1 lb PCBs
5 lb Total
15 year average life

Fluorescent Lighting Ballasts (FL) @:

0.1 lb PCBs
3.5 lb Total
15 year average life

The total numbers of electrical items containing PCBs is summarized in Table 4.

Disposal Costs

The estimated amount (in pounds) of PCB electrical equipment requiring disposal in 1978 is summarized in Table 5.

The proposed regulation requires that all of this material be incinerated with the following exceptions:

> Transformers may be disposed in chemical waste landfills if they are flushed to remove at least 98% of the PCBs;
>
> Capacitors may be disposed in chemical waste landfills until July 1, 1979;
>
> Small appliance capacitors and fluorescent light ballasts in private residences may be disposed in sanitary landfills; and
>
> Small capacitors (including fluorescent light ballasts and HID capacitors) need not be removed from equipment which is disposed in sanitary landfills.

Because of the higher costs of incineration, it may be assumed that few capacitors will be incinerated until after July 1, 1979. The upper estimates of incineration requirements are shown below in option 1 which assumes that all PCB-containing capacitors are removed from equipment before it is scrapped. Option 2 is probably a more realistic estimate of disposal requirements as it assumes that 2/3 of all small appliance capacitors, HID capacitors, and fluorescent light ballasts are not removed from the equipment. Option 2 still results in the requirement to incinerate large numbers of fluorescent light ballasts from commercial and industrial buildings. The PCB's in these ballasts are very well contained, and little migration would be expected in a landfill. Therefore, option 3 is presented as a less expensive disposal alternative which

TABLE 4

Number of PCB Items in Service

	Transformers	Capacitors LHV	Capacitors LLV	Capacitors HID	Capacitors SA	Capacitors FL
Utilities	84,000	7,600,000	1,000,000	800,000	---	---
Commercial and Apartment Buildings	28,000	---	7,500,000	500,000	5,000,000	630,000
Industrial	28,000	400,000	7,500,000	19,200,000	---	130,000
Private Residential	---	---	4,000,000	---	45,000,000	40,000
TOTAL	140,000	8,000,000	20,000,000	25,000,000	50,000,000	800,000

TABLE 5

Disposal Requirements for PCB Electrical Equipment in 1978,
millions of pounds

	TRANSFORMERS			CAPACITORS				
Source	PCB Liq.	Solvent	Trans.	HV	Flu Light Ballasts	Hi Intensity Light Ball.	Large Low Voltage	Small Applianc
Utilities	6.3	4.7	13.6	45.6	–	.3	1.3	–
Large Residential and Commercial	2.1	1.6	4.6	–	140	2	10	1.7
Industrial	2.1	1.6	4.6	2.4	29	7.7	10	–
Private Residential	–	–	–	–	9	Negligible	5.4	15
Total	10.5	7.9	22.8	48	178	10	26.7	16.7

differs from option 2 only in that it allows the continued disposal of fluorescent light ballasts in chemical waste landfills.

The disposal requirements after July 1, 1979, are summarized in Table 6 for each of these three options. The disposal requirements are expected to decrease by about 7 percent per year. Only 5 percent of the PCBs presently in use will still be in use 42 years from now.

The effect of the various options on the disposal of the PCBs is summarized in Table 7.

Chemical Waste Landfill Costs

There are sixteen landfill sites in the U.S. which have been identified as secure or chemical waste landfills by the Office of Solid Waste, EPA. A preliminary survey shows that fifteen of the landfills will accept PCB-contaminated solid waste such as capacitors and transformer internals. However, some of the sites in California serve only a limited locale. The sixteen sites are scattered throughout the country: nine Class 1 landfill sites in California; one in Idaho; one in Illinois; one in Missouri; one in Nevada; two in New York; and one in Texas. These landfills range in size from 32 acres to 890 acres, with most estimating operating lifetimes greater than 10 years. There are no Class 1 landfills in Puerto Rico or any other American possessions or territories.

Costs for disposal in chemical waste landfills are highly variable depending on location and area serviced. Landfills in California are county operated to service specific nearby locales; they impose relatively low charges plus additional state fees. Sites which service a number of

TABLE 6

Annual PCB Equipment Disposal Requirements, after July 1, 1979: millions of pounds

	TRANSFORMERS			CAPACITORS								
				Disposal Option 1[1]			Disposal Option 2[2]			Disposal Option 3[3]		
Source	PCB Liq.	Solvent	Empty Trans.	SLF	CWLF	Incin	SLF	CWLF	Incin	SLF	CWLF	Incin
Utilities	6.3	4.7	13.6	–	–	17.2	0.2	–	47.0	0.2	–	47.0
Large Residential and Commercial	2.1	1.6	4.6	–	–	160.5	100.3	–	60.2	100.3	48.9	11.3
Industrial	2.1	1.6	4.6	–	–	50.5	25.4	–	25.1	25.4	10.1	15.0
Private Residential	–	–	–	29.4	–	0.5[4]	29.4	–	0.5[4]	29.4	–	0.5
Total	10.5 (incin)	7.9 (incin)	22.8 (CWLF)	29.4	–	258.7	155.3	–	132.8	155.3	59.0	73.8

SLF = Sanitary Landfill
CWLF = Chemical Waste Landfill
Incin = Incinerate

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[1] Incinerate all except for residential. SLF(residential): All except 10% of large low voltage capacitors (motor run, air conditioner, etc.) removed for replacement by service shops.
[2] SLF = 2/3 of flu light ballasts, HID, and small applicance capacitors; Incin = All HV and large LV+1/3 (flu lights + HID + small appl.)
[3] SLF = same as option 2; CWL = 1/3 of flu light ballasts; Incin = all HV and large LV+1/3 (HID + small appl.)
[4] 10% of large LV cap. removed by repair shops (central air cond., motors, etc.)

TABLE 7

Disposal of PCB Chemical Substance in PCB Equipment,
after July 1, 1979: million lb/year

Source	TRANSFORMERS			CAPACITORS								
				Disposal Option 1[1]			Disposal Option 2[2]			Disposal Option 3[3]		
	PCB Liq.	Solvent	Empty Trans.	SLF	CWLF	Incin	SLF	CWLF	Incin	SLF	CWLF	Incin
Utilities	4.5	.2	.1	–	–	9.79	0.05	–	9.74	0.05	–	9.74
Large Residential and Commercial	1.5	.1	.05	–	–	6.78	3.35	–	3.43	3.35	1.40	2.03
Industrial	1.5	.1	.05	–	–	5.04	1.86	–	3.18	1.86	0.29	2.89
Private Residential	–			4.12	–	0.01	4.12	–	0.1	4.12	–	0.1
Total	8.	.4	.2	4.12 (16%)		21.71 (84%)	9.38 (36%)		16.45 (64%)	9.38 (36%)	1.69 (7%)	14.76 (57%)

SLF = Sanitary Landfill
CWLF = Chemical Waste Landfill
Incin = Incinerate

[1] Incinerate all except for residential.
SLF (residential): All except 10% of large low voltage capacitors (motor run, air conditioner, etc.) removed for replacement by service shops.

[2] SLF: 2/3 of flu light ballasts, HID and small applicance capacitors
Incin: All HIV and large LV+1/3 (flu lights + HID + small applicances

[3] SLF: Same as option 2
CWLF: 1/3 flu light ballasts
Incin: All HIV and large LV+1/3 (HID + small appl.)

States typically charge from $1.00 to $10.00 per cubic foot of material disposed, excluding freight or State fees. The lower costs are largely found in California and the West where climate and soil type allow location of Class 1 landfill sites close to the counties which are serviced. The facilities in the East service the Eastern States and parts of Canada, and must provide impermeable liners and more stringent monitoring and leachate controls, thus making disposal more expensive.

During 1978, 275 million pounds of capacitors and miscellaneous equipment at 150 pounds per cubic foot, and 22.8 million pounds of transformers at 100 pounds per cubic foot may require disposal in chemical waste landfills. This amounts to 1,830,000 cubic feet of landfill capacity necessary for capacitor disposal and 228,000 cubic feet for transformer disposal. These requirements will drop as land disposal of capacitors is phased out during 1979.

Total costs for chemical waste landfill in 1978 are estimated at 2,058,000 cubic feet x $3.00 per cubic foot = $6.17 million, plus transportation costs of $0.02 per pound (400 mile average trip) x 298 million lbs = $5.96 million. The total chemical waste landfill disposal costs will be $12.13 million. However, this method of disposal is currently specified by the American National Standards Institute (ANSI) voluntary standard for PCBs [2/], and is employed by most utilities and large industrial users. Thus, as much as 50 million lbs of equipment might be disposed of in chemical waste landfills, even if this regulation were not promulgated. The additional costs incurred by the proposed regulation for chemical waste landfill therefore will be less than $10 million in 1978, $6 million in 1979, and about one million dollars per year thereafter under options 1 and 2, since only transformers and containers (such as empty drums) will be authorized for chemical waste landfill disposal after July 1, 1979. This projected demand for chemical waste landfill is not expected to have a significant effect on either the availability or price of such service.

Under option 3, chemical waste landfill would be required by an additional 393,000 cubic feet of fluorescent light capacitors, increasing the chemical waste landfill costs to about $2.2 million per year.

Liquid Incineration

Most PCB-containing liquids are currently disposed of by incineration. The major incinerators operated by Monsanto and the General Electric Co will cease operation before 1978.

Chem-Trol has a patented process of disposal of PCBs by mixing PCB liquids with waste solvents and other hydrocarbons and using the mixture as a fuel in cement kilns for the manufacture of special cements.[3/] A report on the burning of PCBs in a cement kiln of the St. Lawrence Cement Co., Mississauga, Ontario, Canada, is encouraging, in that it has been demonstrated that the waste liquid PCBs can be completely destroyed (greater than 99.99% destruction efficiency) while, at the same time, the HCl liberated in the destruction reaction neutralizes undesirable excess alkali in the cement product. This liquid PCB waste destruction approach shows great promise and a survey is being made by Versar to determine the potential use of this process in the United States.

The Florida Power and Light Company has conducted tests to determine the feasibility of PCB destruction in a power boiler. However, the results are considered preliminary. According to a representative of the company, combustion temperature and dwell time meet the proposed EPA disposal regulations.

A review of test data indicates that destruction of liquid PCBs by co-incineration with sewage sludge is not desirable, in that the average combustion temperatures achieved in this operation (950 degrees K, 150 degrees F) are insufficient to insure 99.99% PCB destruction efficiency.[4/] Criteria for destruction of PCBs in sewage sludge at levels of approximately 25 ppm, dry basis, are discussed in the Federal Register of Thursday, June 3, 1976, Part IV, 1 F.R. 22531).

A total demand for incineration of PCB-containing liquids, including solvents from flushing of transformers, is expected to be approxima 18,000,000 lb/year (10,500,000 lb/yr of PCB liquids and 7,900,000 lb/yr of contaminated solvents). Sufficient incineration capacity is available to handle this volume of PCBs at a cost of about $0.15 per pound, plus perhaps an additional $0.15 per pound for containers and transportation, for a total economic impact of $5.4 million per year. However, since the costs of disposal of the PCBs would be incurred by industry operating in accordance with the ANSI standard, they cannot be attributed to the requirements of the proposed regulation. Total costs of liquid incineration due to the regulation will therefore be approximately $2.2 million per year spent to incinerate the contaminated solvents resulting from flushing transformers to reduce their content of PCBs by 98% prior to disposal in chemical waste landfills.

Solid Waste Incineration

Versar estimates that beginning in the middle of 1979, between 74,000,000 and 258,000,000 lb per year (see Table 6) of capacitors containing PCBs will have to be disposed of by incineration in the United States, depending on the final PCB disposal regulations. The following section summarizes information of the technical and economic factors which can affect disposal of these materials in light of the proposed new incineration regulations.

Based on the latest EPA national survey of commercial hazardous waste incineration facilities, there are approximately twenty liquid waste incineration operations which will not or do not have the capability of handling solid PCB wastes. There are three installations which presently have the capability of handling both solid and liquid PCB-containing wastes and which have the presently required environmental approvals. Additionally, there are two installations which have liquid PCB incineration capability and one installation with both solid and liquid PCB waste incineration capability which are awaiting state operating permits. There is one facility, presently shut down, which has state authorization (as of 1974) to dispose of liquid PCB wastes. The two liquid PCB waste incineration operations carried on by industry -- General Electric at Pittsfield, Massachusetts, and Monsanto at Sauget, Illinois -- will be shut down well before the proposed disposal regulations take effect.

The three currently operating incineration facilities with both liquid and solid PCB disposal capabilities are all owned by Rollins Environmental Services, Inc. These units are located in Logan Township, N.J.; Baton Rouge, Louisiana; and Houston, Texas, and each serves a five to six state area. Data from a recent test burn of shredded capacitors at the Houston facility indicated that this unit processed approximately 700-800 pounds per hour of shredded capacitors containing 20% PCBs. This burn resulted in a PCB destruction efficiency of greater than 99.99%.[5/] The residue from the burn contained approximately 0.1 ppm PCBs. Total dwell time was 2.5 seconds and combustion temperature ranged from 2,000 to 2,400 degrees F. Number 2 fuel oil was used for a heat supply and a fuel oil/solid PCB waste ratio of approximately 1.3 gal. oil/lb solid PCB waste was required. A test burn was also conducted on whole capacitors. PCB levels in the gaseous emissions was less than 0.001 gm/kg of total feed. However, the residue had close to 500 ppm of PCBs making this material unacceptable for disposal in a landfill according to the proposed disposal regulations. Based on these limited data, it is believed that PCB capacitor disposal operations should be conducted with shredded feed material.

In order to conform to the proposed incineration regulation, the Houston unit would have to be modified with suitable instrumentation to continuously measure the concentration of carbon dioxide, carbon monoxide, and oxygen in the stack emissions. In addition, suitable milling equipment would have to be installed in order to supply the shredded capacitor feed to the Houston unit.

The scrubber water discharge from the Houston test burn contained 5-10 ppb of PCBs. This concentration range is given as representative of the three Rollins operations. A 1 ppb PCBs level in the effluent is believed to be practicably attainable through the use of activated carbon treatment. Equipment for this purpose would include a fixed bed system containing activated carbon treatment. Equipment for this purpose would include a fixed bed system containing activated carbon and suitable filtration equipment to remove particulates from the feed to the carbon bed. The spent carbon would be incinerated in the rotary kiln unit after suitable dewatering.

A preliminary estimate for the cost of a complete shredded capacitor disposal unit based on the Houston design is $5.0 million installed. This unit is believed by Rollins to be capable of processing 3000 lb/hour of shredded capacitors. The same unit could handle 500-1000 lb/hour of liquid PCB wastes as a blend in the fuel feed to the incinerator. A breakdown of the investment cost for the dual purpose unit is shown in Table 8. The annual costs of operation have been determined based on data from the Houston facility test burn of shredded capacitors and engineering estimates, and are tabulated in Table 9. All costs are shown in 1977 dollars.

The unit cost of 52¢/lb for solid and liquid PCB waste disposal represents an upper limit for this cost. The major cost item involved, fuel, can be averaged down through the use of inexpensive waste solvents which are currently used by the commercial incineration facilities.

The total annual operating costs for PCBs disposal by incineration, depending on the final EPA disposal regulations, are tabulated in Table 10.

Based on the estimated national distribution of solid PCB wastes, a preliminary assessment has been made of the appropriate distribution of the new incineration facilities which would be needed in 1979. This distribution is tabulated in Table 11.

TABLE 8

Preliminary Engineering Estimate of a Dual Purpose PCBs Incineration Facility

Plant Capacity: 3000 lb/hr shredded PCB capacitors
500 lb/hr PCB liquids

Equipment		Installed Cost
Shredding and Solids Conveying Equipment		100,000
Rotary Kiln, Afterburner, Liquid Combustor and Associated Ducting		2,000,000
Scrubbing Equipment, Tankage, Pumps		500,000
Stack, Foundations, Site and Site Preparation		150,000
Activated Carbon Treatment System including Activated Carbon Beds and Filtration System		250,000
Settling Pond System		10[illegible]
	Sub-Total	3,100,000
Piping and Valves @ 25%		775,000
	Sub-Total	3,875,000
Engineering @ 7%		270,000
	Sub-Total	4,145,000
Contingency @ 20%		830,000
	Total	4,975,000
	Rounded	$5,000,000

TABLE 9

Annual Operating Costs for PCB Capacitor Incineration

Plant Capacity: 3,000 lb/hr of shredded PCB capacitors
500 lb/hr of PCB liquids

Operating Factor: 7300 hours/yr

Capital Investment:	$5,000,000
Variable Costs	
Fuel Oil (#2) 21,900,000 gal, @ 40¢/gal	8,760,000
Direct Operating Labor, 2 men/shift @ $9/hr	157,000
Supervision and Administrative @ 50% of direct operating labor	79,000
Activated Carbon System	122,000
Maintenance @ 20% of capital investment	1,000,000
Power, 100,000 kwh @ 3¢/kwh	3,000
Sampling and Analysis	100,000
Waste Disposal, 9,000 TPY @ $10/ton	90,000
Total Variable Costs	10,311,000
Fixed Costs	
Capital Recovery Rate (10 yrs @ 10%)	814,000
Taxes and Insurance @ 4% of capital cost	200,000
Total Fixed Costs	1,014,000
TOTAL ANNUAL COST	11,325,000

Cost/lb of PCB Solid Waste $0.52

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(1) Assuming a 1:1 fuel/solid PCBs feed ratio, based on a recent EPA sponsored test of incinerating shredded capacitors by Rollins at Houston.

(2) This includes incineration and replacement of 43,000 lb/yr of spent activated carbon.

TABLE 10

Total Cost of PCBs Disposal by Incineration[1]

EPA Option[2]	Total Annual PCB Solids[3] to Incineration, MM lb	Total No. of Facilities Reqd.	Total Annual Operating Cost, $
1	251	12	136
2	131	6	68
3	75	4	45

(1) It is assumed that the waste liquid PCBs would be partly handled in presently existing incineration facilities, and partly blended in the fuel used in the new incineration plants.

(2) As given in Table 3.

(3) These quantities are the estimated amounts to be handled in 1979 when the waste capacitors can no longer be placed in chemical landfills. The amounts to be disposed will decline by approximately 7% per year, thereafter. From Ta[illegible]

TABLE 11

National Distribution of PCBs Incineration Facilities

EPA Option	Total No. of Facilities Reqd.	Total No. of Existing Facilities (1)	Net Number of New Facilities	Location of New Facilities
1	12	3	9	No. Calif. - 1
				So. Calif. - 1
				Colorado - 1
				Illinois - 1
				Ohio - 1
				Georgia - 1
				Virginia - 1 (2)
				New York - 1
				Arkansas - 1
2	6	3	3	California - 1
				Virginia - 1
				Ohio - 1
3	4	3	1	California - 1

(1) These are the three Rollins facilities located respectively in New Jersey, Texas and Louisiana. These will require the addition of shredder facilities and certain monitoring instrumentation to meet the requirements of the proposed regulations.

(2) This is the proposed kepone incineration facility which would be available upon completion of the kepone destruction program.

Incineration costs would be reduced somewhat by operating fewer but larger incineration plants. However, reduction of the number of incinerators would increase transportation costs for waste PCBs.

It is estimated that the net effect on the labor force starting in 1979 (after eliminating the labor needs of chemical landfill operations) would be an increase of 0-30 jobs, depending on the final PCBs disposal regulations adopted.

Transportation

For distances averaging 400 miles and for truckloads or less-than-truckload shipments from 500 lbs up, shipping costs for PCB-containing equipment may vary from $.015/lb to $.05/lb. At greater or lesser distances costs vary proportionately to mileage. Since lesser distances are associat with larger waste amounts (because incinerators are located near centers of population), $.05/lb is a safe upper limit for costs of transporting PCB-containing products and mixtures. At 300 million lbs/year the total transport cost would be $15 million.

By establishing storage at user sites and/or at intermediate collection centers, it would be possible to lower the sum of extra storage and transport costs below this upper bound but not drastically, unless a number of new incinerator sites are optimally located. The siting of new incinerators would require the further trade-off between capital recovery costs of the incinerators and transportation cost reductions. Several additions beyond the three incinerators that accept both solid and liquid

PCB waste now in operation may be required to handle the annual disposal of materials containing PCBs .

The construction of additional incinerators would make the assumption of a 400 mile average trip very reasonable and would push the \$.05/lb maximum for transportation costs alone down to the \$.03 level as an upper limit, but would do so at the expense of greater capital recovery costs for the new incinerators. New incinerators will require at least a year to construct after all approvals are obtained; however, certain existing incinerators might be modified to handle PCBs at lesser capital recovery rates.

Although incineration of PCBs will be a declining business because of the elimination of the source of new PCBs , investment in incinerators that can handle PCBs as well as other toxic substances should be an attractive growth business, because more and more chemicals in industrial use are proving to be toxic and may require incineration under similar conditions. Investment in incinerators with capabilities to recover copper and other metals from transformers will become increasingly attractive, because of the increasing costs of metallic resources.

Net transportation costs will depend upon the particular response of industry to the requirements for incineration capacity, but \$.05/lb for transportation costs seems to be a reliable upper limit with attractive trade-off possibilities for net reductions in total costs.

Decontamination

Because of the potential for accidental spills of PCBs during decontamination and resultant liability, we do not foresee widespread use of this alternative disposal method. There will be some need for decontamination of tank cars, tank trucks, and production machinery as production of new PCBs is phased out. This will not be a major economic impact. Any decontamination performed after this initial period may result in a slight decrease in the costs shown for incineration, but the effect is not expected to be significant because the decontaminating solvent will require incineration under the same kinds of conditions.

Effective decontamination of drums and small containers has been reported for pesticides by triple rinsing of the containers with solvents which contain less than 0.05% of pesticide but have a solubility of 5% or more for the pesticide. Each rinsing uses a volume of solvent approximately 10% of the volume of the container, and the rinsing must be accomplished by repeated contact of the internal surfaces of the container with the solvent. The efficiency of decontamination depends in part on the degree of solvent contact and on the condition of the container surfaces being cleaned. After each rinse, the solvents are collected and incinerated. This procedure is believed to be readily adaptable for PCB containers.

Complete decontamination of askarel transformers does not appear feasible because of their design. However, a high degree (greater than 98%) of decontamination of askarel transformers which are being taken out of service is required. This can be accomplished by thoroughly draining the askarel fluid from the transformer, followed by refilling and re-circulating for several hours with a solvent such as mineral spirits. The solvent is then drained and incinerated. Preliminary results of a test which was performed by Westinghouse for the Federal Railway Administration and based on the above procedure show a 99% reduction in the quantity of PCBs in the transformer. Transformers so treated may then be disposed of in a chemical waste landfill.

Askarel transformers which are kept in service, but retro-filled with a silicone or other oil, should be thoroughly drained of askarel oil prior to refilling with replacement oil. Subsequent drainings and refillings of such transformers will require treatment of the previous retro-fill oil. In the case of silicone oil, Dow Corning reported that treatment with activated carbon will remove the PCBs and permit reuse of the oil. In the case of mineral oil, the initial retro-fill must be incinerated. Subsequent mineral oil retro-fills must also be incinerated if the level of PCB is greater than 500 ppm.

Storage for Disposal

When this regulation becomes effective, large costs will be incurred by several categories of industrial and commercial users of PCB capacitors. Each commercial or industrial building (or complex), and each repair center will be required to establish a special storage center for PCB articles.

Most such storage areas will be quite small. These will be required by the proposed regulations for office and commercial buildings, electrical repair shops, and small industrial operations to store the small capacitors and fluorescent light ballast which are removed during normal maintenance. Such storage requirements for large buildings, or complexes operated by one real estate manager, will be significantly larger. For instance, the World Trade Center in New York City has 250,000 fluorescent light ballasts; replacement of failed ballasts may result in the requirement to store several hundred ballasts per week prior to disposal.

If the small storage areas for accumulation of small capacitors/ ballasts are indoors and accommodate only one 55-gallon drum at a time, no special flooring, diking, or recordkeeping will be required. The cost of establishing such an area will be the cost of procuring a DOT Spec 5, 5B, or 17C openhead drum, marking the drum and the area, establishing a local policy, and policing the collection and storage of the units. Total costs will be about $10 (one man-hour) for drum labeling and setting up and maintaining the storage location; $25 for the initial purchase of one drum, and $15 per year for purchase of a statistical 0.6 of one drum in subsequent years; $80 for first year administrative expenses; and $50 for subsequent years. The small area required by one drum (about 10 sq. feet) will require a non-cash allocation of about $30 per year ($3 per sq. foot) for equivalent rental value of the space. Thus, individual costs for small storage areas would be on the order of $145 for the first year and less for subsequent years, approximately $105 per year.

Special indoor storage facilities which may not now exist will be required by utilities and large industrial and commercial building complexes which may store quantities of used capacitors or repairable PCB transformers. Such storage area will require impermeable floors and dikes. Two thousand such areas, utilizing about 200 sq. ft. per area, would require engineering and construction costs of about $2,000 each for modification of existing storage areas. Equivalent rental costs of $3.00 per sq. ft. still apply, and drum costs would be about $225 per year. Labor costs are estimated at $1,000 per year, and administrative costs at $300. Indoor storage costs will total about $4,125 for the first year, and $2,125 in subsequent years.

Major facilities, devoted only to the repair of PCB transformers are expected to be far fewer (probably about 20), and are believed to be in existance. Therefore, we do not believe that any further economic impact for such facilities will result from the proposed regulation.

Total estimated costs of storage areas will be:

First year:		
Small $145 x 1,000,000 facilities	=	$145,000,000
Large 4,125 x 2,000 facilities	=	8,250,000
Total		$153,250,000
Succeeding years:		
Small $105 x 1,000,000 facilities	=	$105,000,000
Large 2,125 x 2,000 facilities	=	4,250,000
Total		$109,250,000

Marking

The proposed regulations specify marking of both new PCBs and PCB equipment, and of existing PCBs. The impact of the regulations on the manufacturers and users of new PCBs and new PCB equipment will be small because the amount manufactured after 1977 will be small. The two capacitor manufacturers who have indicated that they may continue to make PCB capacitors in 1978 will be faced with about $25,000 in tooling costs to mark the capacitors, and the equipment manufacturers who use these capacitors will also be faced with some marking costs. The total economic impact of the marking regulations on the manufacturers of electrical equipment should be less than $100,000, as summarized in Table 12.

The major costs of complying with the proposed marking regulation will be incurred by the users of existing PCB electrical equipment. The costs of complying with the proposed marking regulations can be divided into two categories: (1) the cost of the specified labels, and (2) the costs of applying the labels. The estimated upper bound costs of complying with the proposed marking regulation are summarized in Table 13.

Estimated label costs are based upon manufacturers' retail prices for lots of 1,000. Unit costs for labels will be extremely small if all labels are manufactured by a few companies rather than many; i.e., the economies of scale will give rise to decreasing average costs. Costs associated with applying the labels, transportation and labor costs, are maximum estimates based on a full-time labeling program. Such costs will be greatly reduced if users' PCB electrical equipment is marked during

TABLE 12

Electrical Equipment Manufacturers' Total Marking Costs
For the Year Ending December 31, 1978
(in dollars)

	Label Costs	Transportation and Labor Costs	Total
Containers	2,700	1,500	4,200
Storage Areas	27	1,000	1,027
Vehicles	20	370	390
Inventory:			
Transformers	3	20	23
Large Capacitors	2,700	40,000	42,700
w Articles	25,000	—	25,000
w Equipment	25,000	—	25,000
TOTALS	55,450	42,890	98,340

Table 13

Electrical Equipment Users' Total Marking Costs for the Year Ending December 31, 1978 (in dollars)

	Label Costs	Transportation and Labor Costs	Total
Utilities:			
Containers	84,780	100,000	184,780
Storage Areas	215	7,960	8,175
Vehicles	200	3,700	3,900
Large Low Voltage Capacitors	27,000	1,000,000	1,027,000
Large High Voltage Capacitors	760,000	8,396,481	9,179,161
Transformers	22,680		
HID Capacitors	10,800	120,000	130,800
TOTALS	905,675	9,623,141	10,533,816
Industrial and Commercial:			
Containers	190,350	350,000	540,350
Storage Areas	269,785	4,996,020	5,26[illegible]05
Vehicles	610	11,300	1[illegible]
Large Low Voltage Capacitors	513,000	9,500,000	10,013,000
Large High Voltage Capacitors	800,000	2,000,000	2,800,000
Transformers	15,120	840,000	855,120
HID Capacitors	258,120	2,868,000	3,126,120
TOTALS	2,046,985	20,565,320	22,612,305
Residential:			
Containers	-0-	-0-	-0-
Storage Areas	-0-	-0-	-0-
Vehicles	-0-	-0-	-0-
Large Low Voltage Capacitors	-0-	-0-	-0-
Large High Voltage Capacitors	-0-	-0-	-0-
Transformers	-0-	-0-	-0-
HID Capacitors	1,080	12,000	[illegible]0
TOTALS	1,080	12,000	13,080
GRAND TOTALS	2,953,740	30,205,461	33,159,[illegible]

routine maintenance operations. For example, it would be more economical for a utility company to have its crews mark the various units during their routine visits to substations for periodic checks, servicing, monitoring, etc., rather than sending crews to equipment sites for the sole purpose of marking PCB electrical equipment.

Several utilities have suggested that additional labeling of transformers and large high voltage capacitors presently in service will not result in improved spill handling. They claim that their present procedures and policies have been adequate in the past, and that continuing education would enable employees to recognize PCB units even though the units will not have a standard identification or warning label. It is difficult to judge the effectiveness of such a program over 40 years, at the time when PCB units become rare in service. However, if satisfactory spill response could be assured without special labeling, the application of the labels could be delayed until PBC transformers and capacitors are removed from service. Table 14 summarizes total marking costs under this scenario. This revision of the proposed regulation would reduce users' 1978 marking costs by approximately 48.2 percent.

Records and Monitoring

The recordkeeping and monitoring costs for incinerators and chemical waste landfills have been implicitly included in the estimated disposal costs for PCBs by those methods. The proposed regulation does not impose any record keeping requirements on the million small storage areas which handle only small capacitors.

TABLE 14

Electrical Equipment Users' Total Marking Costs
for the Year Ending December 31, 1978*
(in dollars)

	Label Costs	Transportation and Labor Costs	Total
Utilities:			
Containers	84,780	100,000	184,780
Storage Areas	81,000	3,000,000	3,081,000
Vehicles	200	3,700	3,900
Large Low Voltage Capacitors	13,500	250,000	263,500
Large High Voltage Capacitors	123,120	2,280,000	2,403,120
Transformers	1,361	25,200	26,561
HID Capacitors	10,800	120,000	130,800
TOTAL	314,761	5,778,900	6,093,661
Industrial and Commercial:			
Containers	190,350	350,000	540,350
Storage Areas	189,000	3,500,000	3,689,000
Vehicles	610	11,300	11,910
Large Low Voltage Capacitors	256,500	4,750,000	5,006,500
Large High Voltage Capacitors	6,480	120,000	126,48[illegible]
Transformers	907	50,400	51,307
HID Capacitors	258,120	2,868,000	3,126,120
TOTALS	901,967	11,649,700	12,551,667
Residential:			
Containers	-0-	-0-	-0-
Storage Areas	-0-	-0-	-0-
Vehicles	-0-	-0-	-0-
Large Low Voltage Capacitors	-0-	-0-	-0-
Large High Voltage Capacitors	-0-	-0-	-0-
Transformers	-0-	-0-	-0-
HID Capacitors	1,080	12,000	13,080
TOTALS	1,080	12,000	13,080
GRAND TOTALS	1,217,808	17,440,600	18,658,408

*Cost estimates are based on the assumption that large capacitors and transformers are not required to be labelled until removed from service and hence gathered for (eventual) disposal.

The 2,000 large storage areas will be required to maintain a perpetual inventory of all items or containers in storage. Since the record for each item must include its weight, origin, and date of entry into the area, clerical costs of perhaps two dollars per item might be expected in addition to a cost of $200 per area to establish the record-keeping procedures. It would therefore be expected that initial costs of $400,000 plus an additional one million dollars per year associated with large capacitors and transformers and an additional one million dollars per year associated with containers might be expected. In addition, the reports will require about one man week per facility or $2,000,000 total). Thus, total recordkeeping costs for storage areas might reasonably be estimated at $400,000 initially, plus $4,000,000 per year thereafter.

In addition, owners of transformers and large capacitors must maintain records as to their location, estimated date of retirement, and date of disposal. Based on a current usage of 140,000 transformers and 8,000,000 large high voltage capacitors at 400,000 locations, and assuming a cost of $5 per transformer or capacitor location, the initial record-keeping costs may be expected to be $2,700,000 the first year, with record maintenance and reporting costs of perhaps an additional million dollars per year.

Total recordkeeping costs are therefore estimated at $3,100,000 initially plus $5,000,000 per year. This will result in an equivalent increase in clerical employment of over 300 jobs. The costs will be widely distributed among utilities and industrial concerns, and should have little impact on prices or market structure.

Summary of Economic Impacts

Estimated capital costs and annual operating costs are summarized in Table 15. The capital investment requirements of the proposed regulations as written are estimated to be about $15 to $45 million for incineration facilities and $4 million for storage facilities. These requirements would be reduced to $5 million for incineration facilities if the less expensive options identified in this analysis are adopted.

Annual operating costs for disposal, transportation, record-keeping, and marking, in accordance with the proposed regulation, are estimated to be from $54.3 million in 1978 and from $97 million per year thereafter. In addition, annual operating costs of storage areas are estimated to be $149 million in 1978 and $109 million in 1979. If the suggested lower cost disposal and marking options were adopted, operating cr for disposal, transportation, recordkeeping and marking would range from $36. million to $45.3 million in 1978 and from $58 million to $65 million in 1979. The total operating costs will decrease approximately 7% each year after 1979.

The proposed regulations will not result in a significant increase in energy demands. Even if all the incinerators were fueled with #2 fuel oil, and the kerosene or fuel oil used to flush the transformers was not used to fuel PCB incinerators, the total energy demand would be equivalent to about 20,000 barrels of oil per day. This is significantly below the trigger level of 25,000 bbl/day which is considered a significant energy demand.

The regulations do not directly have any significant effect on the supply or consumption of any strategic materials. However, strict

Table 15

Summary of Economic Impacts, Millions of Dollars

	Capital Costs	Annual Operating Costs 1978	Annual Operating Costs 1979 and later
Disposal Option 1 (1)			
Incinerator	45		
Chem Waste LF		5	1
Incineration			134
Disposal Option 2 (2) (Probable response to proposed regulation)			
Incinerator	15		
Chem Waste LF		5	1
Incineration			69
Disposal Option 3 (3)			
Incinerator	5		
Chem Waste LF		5	2
Incineration			39
[illegible]posal Transportation			
Option 1		15	15
Option 2,3 (Probable response to proposed regulation)		8	8
Record Keeping		8	4
Marking			
New PCBs	0.1		
Existing PCBs			
Option 1 (4) (Proposed regulation)		33.3	5
Option 2 (5)		17.3	5
Storage			
	4	149	109

(1) Incin. all
(2) 2/3 small cap. to SLF
(3) 1/3 of Fl. Light Ballasts to CWLF
(4) all initially
when removed from service

controls on the disposal of transformers may discourage development of reclamation technology for the copper in transformer windings as the GE incinerator will shut down soon and there are no others able to handle copper windings. Not all transformers have copper windings; many of the newer transformers use aluminum conductors. There are an estimated 100,000 copper/askarel transformers in service, each containing 1,000 pounds of copper. The disposal of these transformers over 40 years would result in the loss of 2,500,000 lbs of copper per year into landfills rather than into reclamation systems. This is considerable less than 1% of the total amount of copper reclaimed each year in the U.S. and is an insignificant portion of the total amount of copper consumed each year.

The impact of the regulations on any specific industry will be proportional to the amount of electricity used, except for electrical contractors, transformer repair shops, appliance repair shops, etc.

The proposed regulations will result in substantial compliance costs for the electric utilities, as this industrial segment has the most intensive use of PCBs capacitors and transformers. The utilities would generate about 35% of the demand for incineration of capacitors (see Table 15, disposal option 2) resulting in a cost to the utilities of $27 million per year.

In addition, much of the cost of complying with the record-keeping and marking requirements will be incurred by the utilities. Total attributable costs to the utilities may be in the range of $30 million per year beginning in 1978. The costs will be included as a component of the cost basis on which the electric rates are established by State regulatory agencies and will therefore be recovered from the consumer of electric power. Based on total annual U.S. electrical sales of $53,462,864,000 in 1976, the proposed marking and disposal regulations will cause an average increase in the price of electricity of about 0.06 percent.

Among small business, perhaps as many as 20 transformer repair businesses will either have to stop handling askarel transformers or install special diked work and storage areas. Because most askarel transformers are handled by GE and Westinghouse and because most transformers are oil filled, there should be little loss of business even if the small independent repair shops stop servicing askarel transformers.

The regulations may result in the development of collection and storage services to reduce storage and transportation charges from numerous small generators of PCB wastes. This would result in increased business opportunities for numerous small labor intensive service businesses, resulting in an increase in small business opportunities and employment.

Conceivably the incinerator business could be dominated by Rollins, which has a sister business in trucking, Macklin Trucking. Macklin or Rollins might very well franchise collector and storage operations in areas that Macklin and Rollins could service. This would also increase small business opportunities by making regulatory expertise available to small operations. Rollins could thus be more confident of a steady supply for their incinerator business and be more willing to undertake the investments required for new sites.

FOOTNOTES

1/ USEPA-OTS. Microeconomic Impacts of the Proposed Marking and Disposal Regulations for PCB's. April 1977. Versar, Inc.

2/ ANSI. American National Standard Guidelines for Handling and Disposal of Capacitor-and Transformer-Grade Askarels Containing Polychlorinated Biphenyls. ANSI-C107.1-1974.

3/ McCord, Andrew T., et al. Chemtrol, U.S. Patent 4,001,031. Jan. 4, 1977.

4/ USEPA. Destruction of Polychlorinated Biphenyls in Sewage Sludge During Incineration. NTIS PB 258 162 1976. Versar, Inc.

5/ USEPA-OSWMP. PCB Capacitor Burn. Unpublished report.

ADDENDUM TO PART II, ECONOMIC CONSEQUENCES, OF THE SUPPORT DOCUMENT FOR PCB RULEMAKING

The Economic Analysis presented in the Support Document for PCB Rulemaking does not fully reflect the regulation as proposed. The Versar study Microeconomic Impacts of the Proposed Marking and Disposal Regulations for PCBs evaluated certain regulatory options that included disposal requirements for some or all fluorescent light ballasts. The Versar study indicated, however, that much of the economic impact of the draft regulations was due to the storage of fluorescent light ballasts prior to disposal. In addition, due to wide dispersion of these items of PCB equipment, over 1,000,000 building maintenance and service organizations would be affected by regulations requiring special storage and disposal by incineration or chemical waste landfill. While recognizing the importance of the magnitude of the PCB problem contained in fluorescent light ballasts, the EPA concluded that special requirements for fluorescent light ballasts could not be practically enforced and deleted those requirements from the proposed regulations. The estimated total costs of complying with the revised regulations were therefore lowered.

The capital costs associated with compliance are now $9.1 million (from $19.1 million) as a result of a two-thirds decrease in the needed incineration capacity. The incineration capacity now required is the same as that required in Option 3, where none of the fluorescent light ballasts go to incineration. The capital costs are broken down as follows: $5 million for new incineration capacity, $0.1 million for marking equipment and labels, and $4 million for the required storage facilities.

Operating costs associated with compliance in 1978 are expected to total not more than $58.3 million. The decrease from $203.3 million is due entirely to revision of the costs of providing storage prior to disposal. The lower cost is the result of having no storage requirements for fluorescent light ballasts, eliminating all of the "small" storage facilities and therefore reducing costs by $145 million in 1978 (see Storage for Disposal in this Support Document). Annual costs are broken down as follows: $5 million for chemical waste landfill changes, $8 million for disposal transportation charges, $8 million for recordkeeping, $33.3 million for marking, and $4 million for maintaining storage facilities. Note that 1978 marking costs are probably conservative since a small portion of those costs are associated with fluorescent light ballasts.

Operating costs in 1979 are expected to total $61 million. The decrease from $196 million is due to the elimination of storage costs from "small" storage facilities and a reduction in incineration charges ($30 million). As with capital costs, the incineration charges will be the same as for Option 3 as presented in the Support Document. The costs in 1979 include $1 million for chemical waste landfill charges, $39 million for incineration charges, $8 million for disposal transportation, $4 million for recordkeeping, $5 million for marking, and $4 million for storage. After 1979, annual operating costs are expected to decrease approximately 7 percent per year as PCBs are removed from service.

These cost estimates are conservative. The actual reduction is likely to be somewhat greater than that discussed above because transportation and recordkeeping costs, which are not included in the above analysis, will also decrease as a result of less flow of material to incineration facilities and the consequent lessening of transportation costs and recordkeeping requirements for the facility operators.

III. OFFICIAL RECORD OF RULEMAKING - PCB MARKING AND DISPOSAL REGULATIONS

A. Proposed Regulation

Part 761 - Polychlorinated Biphenyls (PCBs)

B. Support Documents

PCB Marking and Disposal Regulations - Support Document

C. Public Comments

State of Wisconsin/Department of Natural Resources	Dec. 20, 1976
Mobil Oil Corp.	Dec. 27, 1976
American Electric Power Service Corp.	Jan. 6, 1977
Dow Corning Corp.	Jan. 18, 1977
Lorraine Pappas	Jan. 19, 1977
ACBE Comment	Jan. --, 1977
General Electric Co.	Jan. 19, 1977
General Electric Co.	Jan. 21, 1977
Edison Electric Inst.	Jan. 28, 1977
Westinghouse Electric Corp.	Jan. 28, 1977
National Fisheries Inst.	Jan. 28, 1977
Environmental Defense Fund	Jan. 28, 1977
Mallory Capacitor Co.	Jan. 31, 1977
Prodelec	Jan. 31, 1977
Japanese Materials	Feb. --, 1977
State of Michigan/Department of Natural Resources	Feb. 1, 1977
Cleary, Gottlieb, Steen & Hamilton	Feb. 4, 1977
Stripers Unlimited	Feb. 21, 1977
Monsanto Co.	Mar. 3, 1977
Department of Water and Power, City of Los Angeles	Mar. 3, 1977
The Institute of Electric and Electronics Engineers, Inc.	Mar. 18, 1977
FMC Corp.	Apr. 25, 1977

Documents Submitted at Public Meeting, January 24, 1977

Statement of Judy Good, La Leche League International.

Testimony of Lee R. Ivey for USEPA Public Hearing on PCB Disposal, Washington, D.C., Jan. 24, 1977.

Statement of Lyle R. Salmela, Northern States Power Co.

Statement for Public Meeting by David Usher, Marine Pollution Control, on behalf of Amcord, Inc.

Comments by American Federation for Labor and Congress of Industrial Organizations Dealing with Proposed Rule Making by the Environmental Protection Agency on Disposal, Labeling and Use of Polychlorinated Biphenyls, Jan. 24, 1977. Submitted by Russell M. Bargmann.

Comments Related to Marking and Disposal of PCBs Submitted by N. Ray Clark, on behalf of PCB Ad Hoc Committee of Electronic Industries Association.

List of Attendees

D. Publicly Announced Meetings or Hearings

1. Public Participation Meeting, December 20, 1976

Agenda

41 F.R. 53692, December 8, 1976. "Polychlorinated Biphenyls (PCBs): Formation of PCB Work Group; Notice of Public Meetings; Solicitation of Comments."

USEPA. Stenographic Transcript of Hearings in the Matter of Polychlorinated Biphenyls: Panel Discussion. December 20, 1976 Washington, D.C.

Documents Submitted at Public Meeting, Dec. 20, 1976

Submittal of John Hess, Michigan Dept. of Natural Resources

Submittal of Andrew Melechinsky, Tivian Laboratories, Inc.

Statement of Nathan Ray Clerk, Universal Manufacturing Corp.

Submittal of J. Coleman Weber, Monsanto Co.

List of Panel Members

List of Attendees

2. Public Participation Meeting, Monday, January 24, 1977

Agenda

42 F.R. 1067, January 5, 1977. "Polychlorinated Biphenyls (PCBs): Rescheduling of Public Meeting."

Polychlorinated Biphenyls (PCBs): Public Meeting; Solicitation of Comments.

USEPA. Stenographic Transcript of Hearings in the Matter of: PCBs Public Hearing. Use, Labeling and Disposal of Polychlorinated Biphenyls. January 24, 1977. Washington, D.C.

3. Work Group Meetings

This file contains Agenda, Minutes, and all pertinent material of PCB Work Group Meetings.

a. Non-Federal Register EPA Statements

USEPA. Polychlorinated Biphenyls (PCBs) Schedule for Regulation.

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USEPA, Toxic Substance Section. Polychlorinated Biphenyls (PCBs) Regulation. March 1977.

b. Communications

Intragovernment memoranda, letters, and other correspondence.

Other letters.

4. Reports

ANSI. American National Standard Guidelines for Handling and Disposal of Capacitor-and Transformer-Grade Askarels Containing Polychlorinated Biphenyls. ANSI-C107.1-1974.

ANSI. Letter Ballot on Approval of Revision of ANSI Publication C-107.1-1974 - Guidelines for Handling and Disposal of Capacitor- and Transformer-Grade ~~A~~ Askarels Containing Polychlorinated Biphenyls. Final Draft. Sep. 24, 1976.

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Fort Howard Paper Co. Before the Senate Committee on Natural Resources, Assembly Committee on Environmental Quality, Assembly Committee on Natural Resources: In the Matter of Creating Chapter NR 212 of the Wisconsin Administrative Code Related to Effluent Standards for Polychlorinated Biphenyls (PCBs)

General Electric Co. Wastewater Monitoring Program and Evaluation of Control Measures for Polychlorinated Biphenyls (PCB). Discharges to the Hudson River. Phase I Report. Jun. 1975. Clark, Dietz and Associates, Engineers, Inc.

Hutzinger, O., S. Safe, and V. Zitko. The Chemistry of PCBs. 1974. CRC Press.

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Mallory & Co., Inc. Economic Impact of a Ban on PCB in Capacitors. (With cover letter to Mr. Robert A. Westin, Versar Inc., Springfield, Va.). Aug. 10, 1976.

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E. Other Information

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41 F.R. 23225, June 9, 1976. "Polydimethylsiloxane: Opinion Regarding Use as Coolants for Use in Transformers."

42 FR. 17487-17494, April 1, 1977. "Unavoidable Contaminants in Food and Food Packaging Materials: Polychlorinated Biphenyls (PCBs)." USDHEW 21 CFR Part 109. Docket No. 77n0080.

2. Development Plan

"Request for Approval of a Development Plan to Initiate the Regulatory Process for Polychlorinated Biphenyls (PCBs)."